

BASIC CHEMISTRY IN THE IDENTIFICATION AND EVALUATION OF THERMOCHEMICAL CYCLES FOR HYDROGEN PRODUCTION FROM WATER. Melvin G. Bowman, Los Alamos Scientific Laboratory, Los Alamos, NM 87545.

There is an existing and rapidly expanding market for hydrogen at present. Eventually, production of hydrogen from fossil fuels must be supplemented by large volume production from alternate energy sources. It is probable that such production will utilize nuclear and/or solar energy for the decomposition of water by electrolysis or by thermochemical methods. The inherent higher efficiency and potentially lower cost for thermochemical methods, versus the overall electrolysis path, can be demonstrated. However, realization will require the identification and development of cycles of chemical reactions that approximate the thermodynamic and chemical criteria that define an ideal cycle. These criteria include: (1) Enthalpy changes (ΔH^0) and entropy changes (ΔS^0) for reactions in the cycle should approximate those dictated by the free energy of formation of water and by the high temperature heat available for the endothermic reactions. For known and projected heat sources, rather large ΔS^0 values are required in order for ΔG^0 to be zero with a minimum number of reactions. This implies that the reactions should yield gaseous products. (2) Gaseous reaction products (except for H_2 and O_2) should condense above ambient temperatures in order to minimize separation work. (3) Side reactions or competing reactions must be unimportant. Thus, ΔG^0 values for all potential reactions must be evaluated. (4) Reaction rates for the desired reaction must be sufficiently rapid for practical heat exchangers. Examination of many proposed thermochemical cycles reveals that most do not approximate the above criteria.